SCIENCE & TECHNOLOGY LONG POLES IN THE TENT

Marine Corps Perspectives on S&T Shortcomings Relative to Technology-Supported Training

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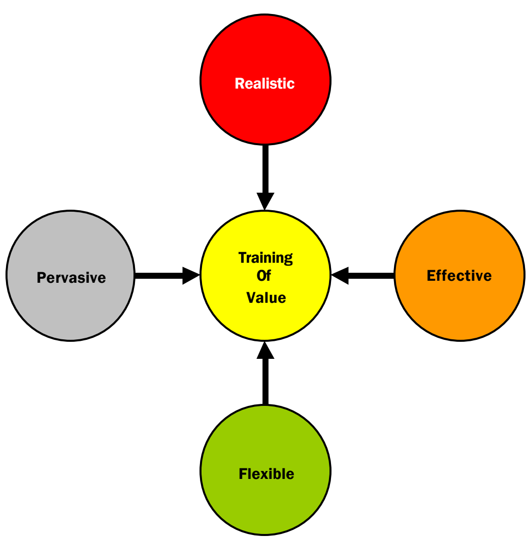
Train like you fight, fight like you train. **This has served as a fundamental philosophical belief throughout Marine Corps history. Creating a realistic training environment during a field-training event or exercise is something we are used to doing. We make training events realistic by doing things like firing live ammunition, jamming our communications nets, increasing tempo, injecting sudden change into the current situation, and using living human opposing forces. It is impossible to create a training environment that is 100% realistic; without an enemy that is fighting against and shooting at you, there is no exact reality. A commander can, though, make choices that can alter the training landscape in such a way as to provoke the proactive and reactive behavior of a training unit.**

What level of realism is required for Technology-Supported Training? Again, a well-conceived view of the training goals must exist, just like for field training. Technology-Supported Training, though, is an avenue that, by definition, should provide lower-cost[1] opportunities to train more robustly. There is a tremendous need to train as realistically as required in simulation[2]. The absence of critical functionalities or environmental realities has a negative training impact. For instance, if a synthetic enemy does not behave as they doctrinally would behave, a training audience will make choices that are not realistic. If this is done often enough, negative learning will result. Another example is weather and its realistic effect upon sensors (radars, lasers, human eyeballs). In this case, weather effects need to be modeled as accurately as necessary to create the desired level of realism.



The following list revolves around those factors that either directly affects realistic Technology-Supported Training or that facilitate realism in Technology-Supported Training. These are all *long poles in the tent*, things that must be done in order to allow Marines to Train Like We Fight. Until these needs are met, Technology-Supported Training will not be used consistently or effectively in support of either training or mission rehearsal.

This paper is intended to alert the Science and Technology (S&T) community to the S&T needs as viewed from the standpoint of those who determine training solutions for the Marine Corps. We welcome questions and comments from the acquisition community, the training community, the S&T community, and our Fleet Marine Forces.

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[1] Lower cost with respect to time and effort as well as financial cost.

[2] Entities controlled directly by the constructive simulation are required to perform all the tasks required to effect a training environment rich enough to train the Marines in simulators to stated standards of performance. Hence, they must interact with each other, as well as with the Marines in the simulators, in a way that stimulates the trainees to execute decision-making as well as procedural skills.

Database Correlation

There is a considerable amount of work ongoing with respect to this topic. For example, TERREX and others are working towards the collection and conversion of various types of data, with the intent to have data at the ready for use in standard military simulations. What we are referring to is much more ambitious than establishing a (much needed) correlated data repository. Consistently, data correlation is the most insidious problem that we encounter when trying to put together training events including two or more different simulations. In order for the military in general and the Marine Corps, specifically, to participate in as complete a fashion as possible in any simulation-based training event, many other types of databases must be correlated (for instance, PC-game-based training tools). Further, force structures, pre-programmed activities (think tracks, air tasking orders, pre-planned fires), pre-planned reactions (think air defense, coordinated on-order fire and maneuver), smart terrain (tagged terrain with metadata), political data, man-made feature data, and weather data must be collected and correlated.

Once we have validated, correlated data, we can then create open-ended federations of systems; we can pre-play and replay exercises from diverse perspectives; and, we can more rapidly engage in training/mission rehearsal.

Cohesive Mission Rehearsal

There exists a fine line between training and mission rehearsal. The former is usually motivated by the potential for military activity; the latter is usually motivated by impending military activity. Further, both require that tasks be executed properly and to established standards, from the most junior Marine trigger-puller to the most senior commander and his staff. Today, mission rehearsal events do not provide an opportunity for all echelons, systems, decision-makers, and supporters to actually practice together with singularity of effort.

In a training event, we have the (relative) luxuries of time and a benign environment on our side; creating a training event that ensures valuable training "from squad to god" is doable. We have the ability to tailor the event(s) to meet the needs of the training objective(s). The ongoing Joint National Training Capability (JNTC) initiative is a decent example of this type of success.

When creating a mission rehearsal event, there are very few luxuries (outside of focus); further, the mission sets the objectives of the rehearsal. The need for every echelon of a unit (squad to god) to receive pertinent rehearsal opportunity is huge; the need for a cohesive rehearsal environment is equally huge. Therefore, what we need is a mission rehearsal environment/system/architecture/capability that supports cohesive actions at all echelons from tactical platform to operational commander.

Rapid Generation of Urban Landscape

Current three-block-war[3] operations in Iraq and Afghanistan are really bringing this need to the forefront. The underlying need is for Marines to train effectively and realistically for urban operations. We have a difficult time providing this training, in part because we do not have adequate facilities. When facilities are inadequate, we turn to technology supported training like simulations. A major shortcoming of our current crop of simulations is the difficulty we have in creating valid urban databases. It simply takes too long to create a full-featured urban database. Time is of the essence; urban terrain changes every time a car is moved. We need the ability to rapidly generate (and update) urban landscape, to include details like infrastructure (underground features, utilities), radio frequency environment, microclimate, lighting effects, rubble, and population, for example. This critical Long Pole meets both training and mission rehearsal needs.

[3] The term "Three-Block-War" was made famous by former Commandant of the Marine Corps, General Krulak, when he spoke of the potential for three different environments (humanitarian aid, mob control/police action, and low intensity conflict) to exist within the span of three city blocks. The term has been used to describe the difficulties of today's tactical environment.

Constructive Simulation Wrap-Around for Urban Exercises

The urban environment brings with it significant challenges, not the least of which is a span of control problem. Commanders often cannot exercise centralized control; therefore, control is decentralized. In the cities, the Non-Commissioned Officer (NCO) is king. Because of this, training for urban missions is focused on small team/unit execution.

We utilize constructive simulation whenever we train staffs[4]. The urban mission problem, being so small unit focused, is not best solved with constructive simulation. The quandary is that we need constructive simulations for the staffs and entity level simulations for the individual and team training. We believe that the solution to this problem is a constructive wrap-around for the urban exercise.

It is important to note that the increased utilization of instrumentation, especially in the live urban training environment, further accentuates this problem. It is probably easier to federate an entity level simulation with a constructive simulation than it is to federate live tracks with a constructive simulation. We need to solve this problem.

C4I System-of-Systems

Recent history shows us that the Marine Corps, particularly MARCORSYSCOM, does not dictate additions and augmentations to the network of operational C4I systems used in the Field. ADOCS and FBCB2 are just two examples of systems that have found their way to the Fleet. Hence, the training programs for these systems are not part of a deliberate lifecycle approach used by typical C4I programs of record. It is our contention that our future has more of these backdoor fielding events.

The training community is left to support development of TTPs, information flows, and positioning of these systems within the context of the existing C4I network. Then, trainers are tasked with making these design decisions accessible to the Operational Users via MTTs, schoolhouse training, and just-in-time training prior to deployment.

To facilitate this teaching event, the Marine Corps requires a tool capable of displaying the architecture of our existing C4I system of systems, can introduce new systems gracefully, and can provide evaluation of some easy-to-understand high-level measures of performance.

Training Range Networks

The Marine Corps' largest range is in 29 Palms, California. It is almost as large as the state of Rhode Island. Controlling that range is a monumental task, one that is made easier because of the investment made years ago to place high-capacity RF on the un-trafficable high ground throughout the base. This infrastructure is being upgraded to meet the increasing need for collection of video, instrumentation, and administrative radio traffic.

We need a way to provide this same level of control/collection/coverage at other bases throughout the Marine Corps without having to be so intrusive. In fact, most other bases/ranges are not blessed with intermittent peaks in all the right places. How can we put OC-3 or better capability throughout a training range without investing millions of dollars? We need help in determining the long-range answer to this question.

Cognitive-Physical Integrated Trainer

We are doing a very good job of instigating cognitive learning through the presentation of realistic and challenging problems via some virtual experience. This can be considered a mental gymnasium, of sorts,

[4] Examples include MEF-level exercises, and Ulchi Focus Lens in Korea.

where a Marine can go to exercise his thinking, just like lifting weight training and aerobics exercise the body. But why not do both? Combat is rife with decision making opportunities, and for the average Marine, combat is an intensely physically demanding event. We need to complement the cognitive with the demands of the physical; we need integrated training so that Marines can get accustomed to the demands of real fighting. There is probably an opportunity for considerable neural and physical functional monitoring to validate the intensity of the training.

Behavioral Modeling

In a simulation, all entities (military, OPFOR, civilian) must exhibit three categories of human decision-making.

1. Execution of scripted action (crawling): plan movement/speed/route, engagement with pre-specified weapons, plan re-supply.
2. Plan construction for primitive action (walking): adaptive planning based upon environment/situation impacts
3. Initiation of re-planning (running): select plans based upon knowledge not only of environment/situation impact, but also supportability and survivability of the plan

We need to be certain that group behavior is modeled as accurately as possible. In reality, when a mission is given to a group, actions are performed because of leader input, training, experience, and analysis. Currently, simulations tend to model behavior around doctrine, which equates to actions performed by training in the real world. What we need is more behavior modeling that takes into account analysis of the known current and suspected situation, a certain degree of learning (hopefully matching that of the training unit) and the effect of leadership. We need to stop crawling and start running.

Multi-Resolution Modeling

Today, one model shows 3d Battalion, 7th Marines as four entities (four companies) while another model shows it as 981 entities (every homo sapien). This is the aggregated constructive model and the entity-level constructive model conundrum. We need both of the models to exist. What we also need, however, is for both of these models to exist in the same federation.

While we're at it; we should not simply stop at tracks and attrition when we create this object model. We need to include communications, situational awareness, morale, tactical employment of coalition forces, and the like. The simulations/models should enforce and render realistic execution in order to ensure we are TRAINING LIKE WE FIGHT.

Multi-Level Security

While this might not be a true S&T problem, it bears mention. The Marine Corps is succumbing to the need to train in a secure environment on classified systems. A problem all the services are facing is the requirement to host training networks of various classifications. We believe that a multi-level security scheme, wherein the architecture is singular, but the data is compartmentalized, is needed in order to help reduce the cost (in infrastructure and individual security rating applications) of future training events.

Realistic OPFOR Via Augmented Reality

This is a critical Long Pole. The Marine Corps values live training over everything (see elsewhere in this paper). We are religious about live fire training. One shortfall of live fire training, however, is the absence of a realistic opposing force. We believe that augmented reality has the potential to solve most, if not all, of the "lack of realistic opposing forces" problem that we are currently working to overcome. Why not augment the impact area with accurate models – digital targets, as seen via an augmented reality device? That way, a Fire Support Team (FiST) would be able to detect, engage, and render battle damage assessment – while on a training range under live fire conditions – without the fakery of exercise controller-induced target manipulation. Such a solution must be flexible and allow for normal team interaction.

Augmented reality enhancement can and should be used in the urban training environment, and not just for infrastructure tagging. We need to investigate the various applications of AR for OPFOR representation in the urban training environment.

Blended Tracks

We believe that blended tracking[5] in the training environment should be all the rage. Instead of building an unaffordable monolithic system to support track collection for live, virtual, constructive combination and after action review, we have to make use of fielded tactical systems, training-range-unique systems, and anything else that can give us a track. The whole becomes greater than the sum of the parts.

The whole also becomes complicated. If we are blending track data from many disparate sources, we have to account for the effect of latency in track transmission times and frequency. Note that we may be receiving track data on the same track, but from two different sources. A relevant example is of an aircraft tracked by both regional FAA radar and an IFF-signal triangulation scheme. In this example, we have two tracks for the same aircraft. Radar updates and their quality are affected by the rotational rate of the radar, the type of the radar, and the distance of the radar from where the tracks will be blended. IFF triangulation updates and track quality are affected by terrain masking, distance of the aircraft from the collectors, and infrastructure quality. In order to provide the most accurate track possible, we have to evaluate the quality of each separate track.[6]

Another effect of excess latency is the arrival of highly accurate but late track data. Assuming that we already updated the track information with lower quality data, we are faced with having to roll back the simulation or track management tool. This is akin to rollback in the world of parallel processing. We feel that this will eventually be a problem that we should start studying today.

Passive Collection of Lessons Learned

The current method of collecting and submitting training lessons learned is so painful that it usually takes significant involvement by the chain of command before any input – much less useful input – is gathered and submitted. This is unfortunate[7]. We need replace the painful system of today with something that supports passive (on unobtrusive) collection of lessons learned.

Improve Battery Life

We do not currently have an inexpensive power source for a SINCGARS radio or DDACT handheld computer that will last consistently more than 24 hours. Battery life is not just a military problem; it is also a civilian problem[8]. This problem is doing nothing but getting worse as we continue to add hand-held digital devices to our repertoire.

Study Areas

We would like to see comprehensive studies of the following topics.

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[5] See accompanying paper; contact the authors if missing.

[6] Using something like Kalman filtering: http://www.cs.unc.edu/~welch/kalman/kalman_filter/kalman.html

[7] Those who ignore history are doomed to repeat it.

[8] How many device chargers do you own? How many do you have to take with you on a TAD trip?

- *Identify the true value of live fire training*. Marines know that live training is "good," just like they know that oxygen is good. This goodness has to do with realism, effectiveness, pervasiveness, and flexibility. What makes for good live training? How good is good enough? How much do we need? How much does it cost to train an infantry battalion?

- *Appropriate/Acceptable mix of live/virtual/constructive training*. This might be a partner study with the first one listed, above. How much virtual/constructive training can we take? Should we take? How much can we afford?

- *Identify negative learning from virtual simulations*. We think we know how real is real enough. Can we quantify this reality? We need to identify the potential for negative learning. We also need to know how some positive experiences might have unintentional negative impact upon other skills.

- *Immersive environments (visualization) and team building/training.* Immersive training has great merit. Some forms, however, are not well suited to improving the interpersonal/small team dynamics that are so vital so success on the battlefield. How do we capitalize on virtual environments while doing no harm to team building/training?

Conclusion

The long-poles issues discussed throughout this paper are all important to the continued success of Technology-Supported Training. The common thread throughout is appropriate realism coupled with economy of use. Technology-Supported Training tools are just that – tools. The best tools are the ones that are wielded efficiently and effectively – and almost always as designed. The Marine Corps is intent on improving the return on training investment by improving the training event. The challenge is now to reduce the number of long poles we see that inhibit future growth, use, and effectiveness of Technology-Supported Training in the Marine Corps.